

### ABSTRACT OF THE DISCLOSURE

A tunable element in the microwave frequency range is described that may include one or more tunable elements that are directly digitally controlled by a digital bus connecting a digital control circuit to each controlled element. In particular, each digital signal is filtered by a digital isolation technique so that the signal reaches the tunable elements with very low noise. The low noise digital signals are then converted to analog control voltages. The direct D/A conversion is accomplished by a special D/A converter which is manufactured as an integral part of a substrate. This D/A converter in accordance with the invention may consist of a resistor ladder or a directly digitally controlled capacitor. The direct digitally controlled capacitor may be a cantilevered type capacitor having multiple separate electrodes or sub-plates representing binary bits that may be used to control the capacitor. A low cost microwave oscillator is disclosed in which some of the filters and oscillators are direct digitally tuned elements.